

THE NATIONAL COLLECTIONS AS BIOLOGICAL STANDARDS

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Gathering of natural history objects must be as old as man himself and a reflection of his inherent curiosity in the world about him. These objects, at first, must have had primarily utilitarian interest, having some real or suspected property of direct survival advantage. Eventually we can imagine that certain aesthetic properties such as color and form began to be important. Later, as he became ever more sophisticated and less concerned with daily survival, such objects were gathered in "cabinets of Curiosities"—pretty stones, fossil bones, brightly colored butterflies, etc. They may have served much the same purpose as modern coffee table picturebooks—as conversation pieces. Ultimately, specimens of the natural world were recognized as important documentation of the kinds of organisms, their geographic distribution, their variability, and their evolutionary history. Systematic collections as biological standards began with that realization, and, with the literature their study has generated, they are still the basic tools of the systematic biologist.

The natural history collections of the U. S. National Museum had a very early origin in the enormous collections brought to the Smithsonian by Spencer Fullerton Baird and added to by virtually every serious biologist since. Increasing by about one million specimens annually, they now total somewhere between 50 and 60 million. One cannot speak of the growth of this major scientific resource without acknowledging the very large contributions to the National Collections made by the Geological Survey, the Fish and Wildlife Service, and the

Department of Agriculture entomologists, by whatever titles these groups may have been known earlier. While the care of the collections is the legislated responsibility of the Smithsonian Institution, they are what they are because of many, many years of cooperative development.

While these National Collections have grown both qualitatively and quantitatively and provide an almost unparalleled research resource, it can be said that we have not yet reached maturity in one important aspect. Although we often receive type materials and important sets of material documenting a particular study, we have not achieved the stature in this country that the British Museum has achieved in Britain, where to have one's collections incorporated is a mark of scientific distinction. Rather than relying on legislation, we must demonstrate our willingness, even eagerness, to serve as the Nation's repository of biological standards, which, like physical standards, must be preserved at a site that has a reasonable chance of caring for them in perpetuity.

It might be well at this point to consider the question of who uses these standards and for what purposes, especially in view of the increasing costs in time, space, and dollars to maintain them. The collections *are* used constantly by systematists in universities (many of whom have disposed of such collections), as well as those in other museums. Last year (1967) we sent 372,886 lots and/or specimens to other researchers over the world. In addition, we hosted 1,195 student or professional research biologists who spent 7,003 man-days in our museum. Most of this sort of use is obviously a service to the systematic community but others use the standards as well. After the Pacific testing of nuclear devices, concern developed in many quarters about radioactive contamination of the environment, especially of resident plants and animals. But how could anyone guess what the condition of the biota was before the tests? Specimens in the National Collections from early expeditions in the test area provided the answer to that question—a biological standard provided the basis for solving this important problem. Other examples of the use of these standards are plentiful. I wonder if the historian considering the development of American cul-

ture can be really thorough without an understanding of the role of the undisturbed biota on which the colonists depended and with which they contended. How can we talk about restoring the quality of the environment without referring to these standards to learn *what* lived *where* and *when*? Another less obvious application of biological standards, that is collections, is in understanding such dramatic, evolutionary explosions as occurred in *Rubus*, the blackberry genus. Before the development of agriculture in the eastern half of the country, the species of this genus were nicely separated from each other by ecological and geographic factors of one sort or the other, but as the forests were leveled to make farm land, new opportunities opened up for once-separate species to commingle genetically and the result has been chaotic for the systematic botanist. His understanding of the environmental situation in the earliest part of the history of this region illuminates the subsequent man-made confusion. The list of examples could be very long, but I doubt that anyone here, at least, will question the importance and value of the National Collections, or that they are used. At this point, I should like to mention the obvious, that the collections to be valuable for future problem-solving must be housed, cared for, and added to—and these present real, very difficult problems.

One of the most critical has always been that of space for housing collections. Growth of collections, even under normal circumstances, is difficult because of space and financial limitations, but we are at this moment entering a period of unparalleled expansion of various types of field biology. When the International Biological Program and the numerous large, federally-supported environmental studies get underway, the enormity of the problem of caring for the mountains of documentary collections that surely should result staggers the imagination. All of us, to varying degrees, will be faced with the problem of how to process these materials so that they are available to biologists generally, systematists, physiologists, ecologists, and perhaps even the molecular types as well. As the numbers of collections grow, there is increasing difficulty with even bringing together the existing specimens of a particular group, and

an even more formidable task of gathering and synthesizing the data attached to the specimens. The mundane problem of housing and caring for these constantly expanding collections poses serious space and time-use problems requiring our most serious consideration of the quality, the nature, and the methods of curating the collections. At one point, I questioned that very much thought was given to what is added to the National Collections, for I am sure we can all agree that undisciplined growth is detrimental to their long-term usefulness. Within the past year we have begun to write what may be termed a rationale for collections growth, and I have been pleased to see numerous examples of correspondence that indicate real judgment on the part of the curators in rejecting substantial collections. In earlier times of our history, as well as that of other collections centers, there may have been more justification for considering the largest collection the most important but the attention given to qualitative considerations is very important at this point in our history.

Aside from being more selective in adding to the National Collections than at times in the past, how can we solve, or at least ameliorate, the problem of space for collections? One approach is to give serious thought to the *nature* of the materials we maintain. Why should each systematics center strive for world-wide, in-depth coverage of all groups of organisms? Isn't it possible to think of an organized sharing of the responsibility of developing the degree of coverage required by the needs of biological research? There *is* precedent for this. Twenty or 30 years ago, several of the large systematic botany centers, all with deep interests in Latin American plants, got together and agreed to divide the job of developing tropical plant collections. Each center concentrated on collecting and studying the plants of a single country or region. In addition, each institution shared representative collections from their special regions with all the others of this informal consortium. The plan worked remarkably well and to some extent it is still observed by the participants. Perhaps the cooperation achieved in that instance could serve as a model for broad consideration of collections-space problems.

Another way of looking at the problem, one that has been suggested previously, is that of inter-institutional transfer of blocks of collections on a long-term loan basis when the borrowing institution has a specialist not represented on the staff of the loaning institution. It is perhaps unnecessary to state the obvious, that there is no center in existence that can hope to employ a specialist for each of even the largest groups of organisms. Could a collection not under active study by a specialist at one institution be housed with a specialist at another? To do this, we would have to develop common curatorial standards that would ensure that the collections of the one institution were cared for equally well by the borrower. We often assume this for present-day, smaller loans and sometimes are disappointed but surely we could determine the standards for specimen cases, the kind and frequency of application of fumigants, and the sort of fire-protection required for preserving each other's collections.

A second major problem of the National Collections, a problem shared with all other Federal systematic centers, is that of grossly inadequate supportive assistance—technicians, aids, research assistants and the like. For the past ten months I have chaired an interagency panel charged with a consideration of the state of health of systematics in the Federal system—some of the panel members are surely in this meeting. We learned that the average level of support is about one supportive person to each professional which is about 30 percent of what has been recommended as adequate for scientists in Federal laboratories. It can scarcely be denied that employing well-trained, experienced scientists and then using substantial parts of their time in non-scientific tasks is the most absurd sort of inefficiency. These problems of space for the collections and the curatorial assistance to manage them must be solved if the National Collections are to continue to be useful biological standards in the future.

One of the most important developments for systematic biology is that of data processing technology as it can be brought to bear on repetitive, non-scientific chores. Efforts are being made, mostly at the pilot-project level, by several museums to

assemble the data associated with some collections in a machine-retrievable form. If one assumes even ten facts in association with each of our 50 million specimens, it is obvious why progress in systematic biology is slow but it also suggests that the task of computerizing even major parts of such an enormous data-base requires very careful planning and decision-making. Machines can handle the problem of cataloging and retrieving published data as well, but the annual exponential growth both in collections and literature makes action increasingly urgent. For data-processing applications to have the greatest usefulness, cooperative data-banks based on inter-institutional agreement will be important. To achieve this cooperation there should be some agreement about *what* information will be deposited in the bank to answer *what* sort of questions. The expense of the automatic data-processing operation is such that the bank should neither contain trivial information nor be queried for it. While it is imperative that we develop a common system, or at least compatible ones, the provincialism of many of us seems to indicate that this will be one of the major problems that may be solved for us by the funding sources and the computer hardware people. In this respect, we need a common approach among the principal natural history museums such as the New York art museum consortium has evolved; a united viewpoint still breeds confidence and attracts the support of others. At the same time we are attempting to develop national cooperation, we need to consider how we can work closely with major collections centers in other parts of the world. Free access of systematic information is necessary for the maintenance of the position of systematic biology and closely allied biological disciplines as primary contributors to science.

As we have heard from some of the preceding speakers, a beginning has been made in the area of recording information associated with new collections and to some extent with the older collections as well. While it may well be impractical to think of computerizing the data on all 50 million collections, this surely should not discourage us from storing data at some appropriate level and in some instances to the specimen level.

I think we must face the fact that one of the most substantial problems in the area of data-handling is ourselves. Our generally narrow specialties often lead us into a sort of scientific isolationism, an inwardly directed concern for our own interests. We are often constrained by a traditional mode of operating, which we feel uncomfortable about discarding or modifying. Consequently, as we face the increasingly critical need to recover data from collections and associated literature, we may respond by burrowing more deeply in our traditional methods of data-gathering and data-handling with consequent loss of time for a function that is not always recognized as part of the systematic job—interpretation of the data we gather and organize. The Museum of Natural History, with the strong backing of the administration above, is seeking appropriated funds for carrying out the kinds of data-processing applications that will make the information in the National Collections more available to the entire scientific community. The pilot programs now current in the museum, supported by the HEW contract, is an effort in which we can all share the leadership role that is so appropriate for those of us associated with these Collections. It is *not* an effort of one person or even of a small group of curators, but rather a means of getting started toward the long-range goal of making the collections more significant for ourselves and for our colleagues, many of whom expect us to provide such leadership.

If the National Collections are biological standards, then we who are the keepers must be prepared to lead, to discard the traditional when it no longer meets needs, for if the standards fail to provide the information needed to solve problems, they will cease to have importance to anyone but ourselves.